

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re patent application of

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Corres. to PCT/EP2004/010328

For: HEATING ASSEMBLY COMPRISING A PTC ELEMENT, IN PARTICULAR FOR  
A MOTOR VEHICLE

TRANSLATOR'S DECLARATION

Commissioner for Patents  
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Sir:

I, the below-named translator, certify that I am familiar with both the German and the English language, that I have prepared the attached English translation of International Application No. PCT/EP2004/010328, and that the English translation is a true, faithful and exact translation of the corresponding German language paper.

I further declare that all statements made in this declaration of my own knowledge are true and that all statements made on information and belief are believed to be true; and further, that these statements were made with the knowledge that willful, false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful, false statements may jeopardize the validity of legal decisions of any nature based on them.

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Date: March 30, 2006

  
Name Derek Ernest LIGHT

For and on behalf of RWS Group Ltd

Heating assembly with a PTC element, in particular for  
a motor vehicle .

5 The invention relates to a heating assembly with a PTC  
element, in particular for a motor vehicle, according  
to the precharacterizing clause of claim 1.

DE 101 44 757 A1 discloses a heating assembly with a  
PTC element for passenger vehicles, a supplementary  
10 heating system being provided, having a heating element  
through which heating air flows during operation of the  
supplementary heating system and having at least one  
air outlet opening in the foot region of a passenger  
compartment, to which the heating air is conducted. To  
15 allow a vertical temperature stratification that is  
also comfortable in particular for seats at the rear to  
be produced in the passenger compartment in a flexible  
way, the heating element takes the form of an  
electrical PTC element, which is arranged directly at  
20 the air outlet opening in the foot region. A  
supplementary heater of this type still leaves  
something to be desired. According to one disclosed  
exemplary embodiment, a PTC element in the form of a  
number of heating honeycombs is arranged in a plastic  
25 frame (not described in any more detail), which  
surrounds the air outlet opening.

The attachment of contact plates to PTC elements  
conventionally takes place by means of an adhesive,  
30 insulating adhesives with a resistivity of over  
10,000 ohms  $\times$  cm or conducting adhesives with a  
resistivity of under 10 ohms  $\times$  cm being used -  
depending on the application. Such bonds between the  
contact plate and the PTC element leave something to be  
35 desired.

The object of the invention is to provide an improved  
heating assembly with a PTC element.

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This object is achieved by a heating assembly with a PTC element having the features of claim 1. Advantageous refinements are the subject of the subclaims.

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According to the invention, a heating assembly with at least one PTC element is provided, the PTC element being arranged between contact plates which serve for making electrical connection, the contact plates and  
10 the PTC element being bonded by means of an adhesive which has a resistivity of at least 50 ohms  $\times$  cm and at most 500 ohms  $\times$  cm, preferably of at least 80 ohms  $\times$  cm and at most 150 ohms  $\times$  cm, in particular of 100 ohms  $\times$  cm  $\pm$  10%.

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Allowance for heating and safety aspects is made at the same time if an adhesive with a certain resistivity, in particular an adhesive with a resistivity of 50 to 500 ohms  $\times$  cm, is chosen, the PTC elements being bonded  
20 to contact plates by this electrically conducting adhesive. The resistivity is to be chosen here on the one hand such that the risk of a short-circuit between the contact plates is avoided. On the other hand, the resistivity is to be chosen such that, in the event of  
25 the heating assembly being damaged as a consequence of aging, the adhesive layer can undergo enforced relaxation, averting direct contact between the PTC element and the contact plates, but the adhesive layer having adequate electrical conductivity to maintain the  
30 heating function should this occur. In this case, the adhesive layer has an additional electrical resistance and displays acceptable heating output. The advantage of the invention is that in this case the heating function is not disturbed. The aforementioned range  
35 for the resistivity has been found to be that which is most suitable.

It is preferred for the layer thickness of the adhesive between the PTC element and a contact plate before enforced relaxation to be negligible and after enforced relaxation to be at most  $0.02\text{ }\mu\text{m}$ , in particular  $0.01\text{ }\mu\text{m}$  +/- 10%.

Instead of an adhesive, a solder with a corresponding resistivity may also be used.

The invention is explained in detail below on the basis of an exemplary embodiment with reference to the drawing, in which:

Figure 1 shows a view of a heating assembly according to the invention,

Figure 2 shows an enlarged section through the heating assembly from Figure 1 along the line II-II in Figure 1,

Figure 3 shows a section along the line III-III in Figure 2,

Figure 4 shows a representation corresponding to Figure 2 after enforced relaxation,

Figure 5 shows an equivalent circuit diagram which illustrates the resistances, and

Figure 6 shows an equivalent diagram corresponding to Figure 5 which illustrates the resistances after enforced relaxation.

In the case of a PTC heating assembly 1 with ceramic PTC elements, a PTC element 2 is respectively bonded in place between two contact plates 3 (positive terminal) and 4 (negative terminal) that are arranged parallel to each other, in the present case by means of an adhesive

5 which has a resistivity of approximately 100 ohms  $\times$  cm. Corrugated ribs 6 are attached by means of a corresponding adhesive bond on those sides of the contact plates 3 and 4 which in each case lie opposite  
5 the PTC element 2, and a respective further contact plate 3 and 4 is attached to said corrugated ribs, likewise by means of a corresponding adhesive bond. Arranged around the assembly described above is a plastic frame 7. The flow direction of the air is in  
10 the viewing direction in the case of Figure 1.

Hereafter, the length of a PTC element 2 is denoted by  $L$ , in the present case 035 mm, the width of the PTC element 2 by  $l$ , in the present case 8 mm, and the  
15 thickness of the PTC element 2 by  $e$ , in the present case 1.4 mm. The average thickness of the adhesive layer between the surface of the PTC element 2 and a contact plate 3 or 4 is denoted by  $\eta$ , in the present case 0.01  $\mu\text{m}$ . The width of the adhesive around the PTC  
20 element 2 between the contact plates 3 and 4 is denoted by  $s$  and in the present case is 1 mm.

The voltage between the contact plates 3 and 4 is denoted by  $U$  and, according to the present exemplary  
25 embodiment, is 13 V, but may also be greater, for example 48 V.

The resistivity of the adhesive 5 is denoted by  $\rho_{\text{adhes}}$ , the resistance of the PTC element 2 by  $R_{\text{PTC}}$ , the  
30 resistance of the adhesive layer between the PTC element 2 and the contact plate 3 or 4 by  $R_{\text{adhes}}$ .

The output of the PTC element 2 is denoted by  $P_{\text{PTC}}$ , the output of the adhesive 5 between the contact plates 3 and 4 by  $P_b$ , the output of the PTC element 2 in  
35 connection with the adhesive 5 without enforced relaxation by  $P_{\text{adhesion} + \text{PTC without enforced relaxation}}$ , the output of the PTC element 2 in connection with the adhesive 5

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with enforced relaxation by  $P_{\text{adhesion}} + P_{\text{TC}}$  after enforced relaxation, the overall output by  $P_{\text{total}}$ .

Here, the resistance  $R_{\text{adhes}}$  of the adhesive 5 between the PTC element and a contact plate 3 or 4 and the resistance  $R_b$  of the adhesive 5 surrounding the PTC element 2 is obtained as follows:

$$\begin{aligned} (1) \quad R_{\text{adhes}} &= \rho_{\text{adhes}} \times \eta / (L \times l) \\ (2) \quad R_b &= \rho_{\text{adhes}} \times e / (2 (L+1) \times s) \end{aligned}$$

Equivalent diagrams for the circuits of the resistances are represented in Figures 5 and 6.

The output  $P_{\text{adhesion}} + P_{\text{TC}}$  without enforced relaxation and the output  $P_{\text{adhesion}} + P_{\text{TC}}$  after enforced relaxation are obtained by

$$\begin{aligned} (3) \quad P_{\text{adhesion}} + P_{\text{TC}} \text{ without enforced relaxation} &= U^2 / R_{\text{PTC}} \\ (4) \quad P_{\text{adhesion}} + P_{\text{TC}} \text{ after enforced relaxation} &= U^2 / (2R_{\text{adhes}} + R_{\text{PTC}}) \end{aligned}$$

To bring about optimum efficiency of the PTC element 2, the ratio  $P_{\text{PTC}}/P_b$  should be chosen to be as great as possible. Furthermore, however, the ratio of  $P_{\text{adhesion}} + P_{\text{TC}}$  without enforced relaxation/ $P_{\text{adhesion}} + P_{\text{TC}}$  after enforced relaxation should lie as close as possible to 1. In this case, the ratio of  $P_{\text{PTC}}/P_b$  lies in particular between about 4 and 40 and the ratio of  $P_{\text{adhesion}} + P_{\text{TC}}$  without enforced relaxation/ $P_{\text{adhesion}} + P_{\text{TC}}$  after enforced relaxation lies between about 1.2 and 1.02.

List of designations

- 1 heating assembly
- 2 PTC element
- 3 contact plate
- 4 contact plate
- 5 adhesive
- 6 corrugated rib
- 7 plastic frame